PROGRESS IN ANGULAR ACCELERATION MEASUREMENT

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As the sophistication of protective devices, testing procedures, and instrumentation has increased, accurate measurement of rotational motion has become more important to biomechanical research.

For several years, in the early 1970's, Endevco's Model 7301 Angular Accelerometer was the state-of-the-art instrument for rotational measurements. It was made up of three piezoelectric sensors which generated an electrical output when stressed by a rotating inertial mass. Because of it's complexity, it required great care and many time-consuming adjustments to "tune out" it's inherent sensitivities to transverse motions. It was very expensive, and never totally satisfactory for biomechanical measurements.

Sometime later, spatial arrays of six or nine accelerometers were used to sense motion in all six degrees of freedom simultaneously. However, the calculations required to reduce the (six or nine) linear accelerations to six degrees of freedom data, tended to multiply any error effects. Therefore, to yield accurate data, the accelerometers needed to be almost totally error-free. This is virtually impossible and cost tends to increase exponentially with absolute accuracy.

Wouldn't it be nice to have a single instrument, of reasonable size and weight, that would produce six electrical outputs proportional to acceleration in the six degrees of freedom of simple linear and angular motion? Can this be done with high accuracy? We at Endevco believe that goal is within our grasp.

As an outgrowth of other transducer development programs, a new concept for angular acceleration measurement has emerged. The prototype had a mass of less than 50 grams (for a single-direction rotational accelerometer) in a cylinder

approximately 5/8 inch diameter by 3/4 inch long. Sensitivity is 6 μ V per rad/sec^2 and resonance frequency is about 2500Hz. Amplitude linearity is better than 2% from 0 to 50,000 rad/sec^2 and and it can withstand ten times overrange. Sound too good to be real?

Yes, it is too good to be real. Although the first working model had negligible sensitivity to motion in transverse directions, as the design has been defined and made producible, the transverse sensitivities have increased. We believe that it would not be useable for biomechanical research without improvements.

Our current efforts are two-fold. First, we are continuing design/development efforts to improve performance characteristics. At the same time we are engaged in a market survey and financial analysis to determine whether sufficient market exists to make further development economical. We have had great interest shown by manufacturers of reciprocating engines and other rotating equipment. It appears that the combined markets for rotational accelerometers may make this product financially justifiable.

We will keep you informed.

P.S. (written after the above presentation)
Market survey has revealed that the product development is feasible. Endevco is building six prototype units for evaluation by biomechanical researchers and machinery manufacturers. They should be available by April or May of 1981.